

reacting the reactants on the exposed portion of the metal contact pad, thereby forming a solder contact only on the exposed portion of the metal contact pad and not on the insulating layer ; [and]

annealing the solder contact to form a solder ball contact having a diameter in a range of about 2.5 microns to no greater than 100 microns ; and

leaving remaining portions of the insulating layer as a passivation layer.

REMARKS

Applicant has carefully reviewed and considered the Final Office Action mailed on September 27, 2001, and the references cited therewith. In response to this Final Office Action, Applicant has filed the present Request for Continuing Prosecution (RCE) and has amended claims 1, 9 and 11- 12 and canceled claims 2, 13-23, 66, 67, 69, 70, 72-75; as a result, claims 1, 3-12, 64, 65, 68 and 71 are now pending in this application. Applicant notes that a different attorney is now prosecuting the present patent application. Reconsideration of the claims is respectfully solicited.

§103 Rejection of the Claims

Claims 1-24 and 64-67 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Cook et al. (U.S.4,650,548) in view of Thomas (U.S.4,661,375) and Strube et al (U.S. 4,650,548). Applicant respectfully traverses this rejection in light of the amendments made to the claims and the remarks in support of patentability below.

Applicant is familiar with the references relied upon by the Examiner in that the named inventor of the present patent application (Dr. Paul A. Farrar) is also a named inventor of the Cook et al. patent and did much early work on so called "C4 joints" (Controlled Collapse Chip Connection). The Cook et al. patent is directed at the pad metallurgy underlying the C4 solder ball whereas the present invention is directed at selective deposition onto a metallurgy pad without the use of a removable mask. By selectively depositing the solder onto only the exposed metal pad, a significant cost saving is achieved in manufacturing extremely small solder balls. Selective deposition places the solder onto one area (metal pad) and not on another area

(insulator) such that there is nothing to remove from the insulator area. In all the references of record, some form of mask is required to remove unwanted solder. Such masks are molybdenum masks, photoresist resins, insulators, or other removable materials. In contrast to this, the present invention selectively deposits the solder without the need to later remove a mask. Thus, the claims have been amended in an attempt to clarify the role of "selective" deposition using CVD or electrolytic deposition in conjunction with the absence of a mask.

Analysis of the Cook et al. Patent

In the Cook et al. patent, the described prior art used a removable metal (molybdenum) mask to prevent solder from being applied to anywhere but the pads. However, the molybdenum mask limited the size of solder pads to be 100 microns or more (see column 2, lines 10-16). To make smaller pads, a photoresist lift-off mask is used to define a removable mask (column 2, lines 21-25). To remove the mask, process chemicals such as perchlorethylene or other chlorine chemicals are used to strip the photoresist mask after the solder is applied to the pad. Cook et al. determined that the existing metallurgy of the pad was damaged by the exposure to chlorine (see column 2, lines 55-57). So Cook et al. constructed a new metallurgy for the pad to resist the chlorine damage (column 2, lines 50-55). Cook et al. did not use selective deposition of solder and did use a removable mask.

Analysis of the Thomas Patent

In the Thomas patent, an implication is made that one could form a C4 joint without the use of a mask. Thomas states "Besides eliminating the photomasking operations involved in vacuum evaporation and electroplating, a solder reflow step is not required to spheridize the bumps 10-10." (See column 3, lines 63-66). Thomas does not explicitly state that the initial solder ball is formed without a mask. Thomas merely states that one starts with a solder ball and builds it up in height by successive immersions in solder baths having differing ratios of Pb and Sn.

Analysis of the Strube et al. Patent

The Strube et al. patent describes electrolytic build-up of solder on a printed circuit board. A "galvano resist" pattern is used as a mask which is then stripped off after deposition. (See Figure 1 and see step 8 in column 2, line 26 and step 8 in column 2, line 62.) This is not a selective deposition.

Analysis of the Combination of the Patents

The Cook et al. patent describes depositing the solder by evaporation and with a mask. The Examiner relies of the statement in Cook et al. that the solder contact could be formed by "other suitable means." This type of generalized statement is often included in patent applications in an attempt to broaden the possible equivalents for elements in the claims. In this use, the phrase "other suitable means" has no other support or description in the Cook et al. patent. Hence, there is no teaching as to what would or would not be a suitable means. There must be some reasonable limit to the equivalent means but we are left to guess what that is.

The Thomas patent is combined with the Cook et al. patent to provide immersion as an "other suitable means" for depositing solder. However, Cook et al. uses removable masks and evaporation for the deposition. Thomas et al. uses immersion for the deposition. The claims of the present patent application have been amended to clarify that no removable mask is used and we do not claim immersion as a deposition means.

The Strube et al. patent is combined with the Cook et al patent to provide electrolytic deposition as an "other suitable means" for depositing solder. However, both Cook et al. and Strube et al. use removable masks. The claims of the present patent application have been amended to clarify that no removable mask is used.

The pending claims as amended are distinguishable over the combination of patents cited by the Examiner. For example, independent claim 1 includes the limitation of "depositing solder on the exposed portion of the metal contact pad using selective chemical vapor deposition or selective electrolytic deposition, thereby forming a solder contact by selectively depositing solder only on the exposed portion of the metal contact without depositing solder on the insulating layer and without removing a remaining portion of the insulating layer." The focus in this claim

AMENDMENT & RESPONSE UNDER 37 C.F.R. § 1.116 - EXPEDITED PROCEDURE

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avoids immersion techniques and maintains the insulator layer as a passivation layer.

Independent claims 9 and 12 contain similar limitations. Since the combination of patent cited by the Examiner fail to teach or suggest these limitations in independent claims 1, 9 and 12, the rejection of these claims under 35 U.S.C. §103(a) fails. Reconsideration of the claims is respectfully solicited.

Conclusion

Applicant respectfully submits that the claims are in condition for allowance and notification to that effect is earnestly requested. The Examiner is invited to telephone Applicant's attorney (612-373-6904) to facilitate prosecution of this application.

If necessary, please charge any additional fees or credit overpayment to Deposit Account No. 19-0743.

Respectfully submitted,

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CERTIFICATE UNDER 37 CFR 1.8: The undersigned hereby certifies that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to: Box RCE, Commissioner of Patents, Washington, D.C. 20231, on this 17th day of January, 2002.

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